

Nematodes and Plant Health: Legislation and Sampling Strategies in Decision Making for Nematode Management*

Martin G. Ward

Plant Health & Seeds Inspectorate, MAFF, Foss House, York, YO1 2PX, UK

& Sue Hockland†

Central Science Laboratory, MAFF, Harpenden, Herts, AL5 2BD, UK

(Received 23 May 1995; revised version received 11 June 1995; accepted 12 December 1995)

Abstract: UK plant health measures are based principally on the Plant Health (Great Britain) Order 1993 and the similar Order covering forestry pests, both implementing EU Directive 77/93/EEC, as amended. Nematode species of quarantine status are *Aphelenchoides besseyi*, *Bursaphelenchus xylophilus*, *Ditylenchus destructor*, *D. dipsaci*, *Globodera pallida*, *G. rostochiensis*, *Longidorus diadecturus*, *Nacobbus aberrans*, *Rhadinopholus similis*, *Xiphinema americanum sensu lato* (non-European populations), and *X. californicum*. Soils are tested for freedom from *Globodera* spp. and virus vector nematodes under certain certification schemes and where necessary, for export crops. EU Marketing schemes require visual freedom from quality-affecting nematodes. Soil samples normally comprise 500 g of soil from 100 cores per 4 ha (or less).

Key words: Plant Health Legislation, plant-parasitic nematodes.

1 INTRODUCTION

The term 'Plant Health' is used to cover phytosanitary controls against quarantine organisms and official certification schemes for the health of planting material. In England and Wales these functions are the responsibility of the Ministry of Agriculture, Fisheries and Food (MAFF). The Plant Health Service of MAFF comprises the Plant Health Division with overall policy responsibility, the Plant Health and Seeds Inspectorate, and the Plant Health Group within the Central Science Laboratory MAFF (CSL), which provides scientific

support to the development and implementation of policy.

A quarantine pest is 'a pest of potential national economic importance to the country endangered thereby and not yet present there, or present but not widely distributed and being officially controlled'.¹ The organisms which meet these criteria are damaging, difficult or expensive to control, and are usually slow to spread naturally, although they may be spread inadvertently by human activity.

Measures to restrict the movement of quarantine pests by international agreement date back to the 1880s. The current basis for phytosanitary controls is the International Plant Protection Convention (1951). The Sanitary and Phytosanitary Agreement² of the General Agreement on Tariffs and Trade (GATT) stipulates that controls must be proportional to the risk averted, developed in accordance with international standards, and

* Based on a paper presented at the symposium 'The management of problems caused by plant parasitic nematodes' organised by K. Evans on behalf of the SCI Pesticides Group and held at 15 Belgrave Square, London, on 25 April 1995.

† To whom correspondence should be addressed.

must not form a disguised barrier to international trade.³

Technical co-operation between Plant Health services is facilitated by Regional Plant Protection Organisations, one of which is the European and Mediterranean Plant Protection Organisation. Member States of the European Union (EU) have also made substantial progress in harmonising their approach to Plant Health.⁴ Directive 77/93/EEC as amended (the 'Plant Health Directive'), sets out the measures which Member States must take in order to safeguard plant health within the Community. The Annexes to the Directive list the organisms which may not be moved into or within the Community and the additional measures to be taken against their introduction and spread. The Directive provisions are implemented in Great Britain by The Plant Health (Great Britain) Order 1993 and the Plant Health (Forestry) (Great Britain) Order 1993. The Schedules of these Orders contain the same organisms and requirements as the Annexes of the Directive.

The responsibilities of the Plant Health and Seeds Inspectorate (PHSI) are to check compliance with Plant Health legislation in England and Wales, including inspection of plants moving into and within the Union, phytosanitary certification of exports to meet the requirements of importing countries, eradication or containment of pests when appropriate and certification of certain planting material for health status and true-ness to type. Nematodes are a significant factor in all these areas of work, but many are not readily detected by visual inspection, so sampling for laboratory diagnosis is used more frequently than for other groups of organisms.

Over the last two years the Central Science Laboratory MAFF have diagnosed 34 different genera of nematodes on 851 samples submitted by PHSI. Over the same period over 3000 soil samples have been submitted to ADAS laboratories for examination for potato cyst nematodes (PCN), *Globodera pallida* (Stone) Behrens and *G. rostochiensis* (Wollenweber) Behrens.

2. LISTED QUARANTINE NEMATODES FOR THE EU

2.1 *Longidorous diadecturus* Eveleigh & Allen

This North American species is included in the quarantine lists in response to concerns that it may be a virus vector.

2.2 *Nacobbus aberrans* (Thorne) Thorne & Allen

The 'false root knot nematode' is one of the most damaging nematode pests of potatoes across the South American centre of origin of this crop. It has been

recorded on two occasions from glasshouse sites in Europe, but these outbreaks are believed to have been eradicated. Additional quarantine measures which provide some protection against introduction include a prohibition on imports of soil from non-European countries, a prohibition on imports of potatoes from most non-European countries and strict conditions covering the introduction of potato breeding material from South America.

2.3 *Xiphinema americanum sensu lato* (non-European populations) *Xiphinema californicum* Lamberti & Bleve-Zacheo

The reason for listing 'non-European populations' of *X. americanum* in this, taxonomically difficult, group is to exclude strains which can transmit such viruses as the Tomato ringspot and Tobacco ringspot nepoviruses; European strains are not virus vectors. The viruses are quarantine organisms for the EU in their own right, but prohibiting the introduction of their vector provides an additional level of protection.

2.4 *Globodera pallida* and *G. rostochiensis*

In addition to the Plant Health Directive, there are three directives covering eradication or containment of specific pests of potatoes. One of these, Directive 69/465/EEC (at present under revision), lays down the measures to be taken against PCN. These include scheduling of infested land to prohibit the growing of plants destined for transplanting or of potatoes, other than (a) resistant cultivars, (b) early crops which mature before the pest has completed its life cycle, or (c) following treatment with nematicides. It has been estimated that the potential losses caused by these pests, if no action were taken, would be about £36 M per year, or about 6% of current total production.⁵

2.5 *Aphelenchoides besseyi* Christie

This pest has been reported as causing serious losses to rice in Japan and the USA, and has been reported occasionally on this host in the EU as well as on strawberries, its other main host, but there are no recent reports of significant damage. The main means of spread is on rice seed or young strawberry plants. The use of certified strawberry planting material appears to provide adequate protection against the pest on this host.

2.6 *Bursaphelenchus xylophilus* (Steiner & Buhrer) Nickle

Pine wood nematode (PWN) is currently the subject of debate between the EU and Canada. It causes limited

damage in North America, where it is indigenous, but since it was introduced to Japan at the beginning of the 20th century it has caused widespread loss of pine forests. Timber losses in Japan still exceed 10^6 m³ per annum. The risks posed are highest for southern Europe where there are species of *Monochamus* beetles similar to those which vector the nematode in North America and where climatic conditions are more favourable to the development of the pest. However, since 1993 goods have moved freely within the Single European Market and to protect vulnerable regions all EU countries have required that conifer wood should be heat treated to a core temperature of 56°C for at least 30 min. This has caused considerable concern in Canada, which has traditionally been a major supplier of untreated timber to the UK. Alternatives to the expensive heat treatment process, based on the exclusion from the processing chain of wood attacked by the vector, have been tried but have not provided a sufficiently high level of assurance.

The current position is that the EU experts are conducting a full Pest Risk Analysis and the results should be available in 1995 for consideration by representatives of Member States on the Plant Health Standing Committee of the EU.

2.7 *Ditylenchus destructor* Thorne

Potato tuber nematode is a comparatively minor pest in the EU despite its wide distribution, relatively wide host range and the serious damage which can be caused to potato crops in favourable conditions. The use of certified seed potatoes will continue to be an important factor in minimising risk of damage from this pest.

2.8 *Ditylenchus dipsaci* (Kuhn) Filipjev

Stem and bulb nematode is a damaging pest of a wide range of temperate crops, including narcissus bulbs, which represent an important plant export from the UK, with a value exceeding £6 M per annum. Bulbs traded to commercial growers anywhere in the EU (including the UK) must be inspected and given a plant passport to indicate freedom from *D. dipsaci*. Bulbs destined for the retail market within the Community have only to be visually free from this pest. Treatment with hot water and formalin, verified by feedback from inspection results, enables the UK narcissus crop to be kept substantially free of what could otherwise be a highly damaging pest.

2.9 *Radopholus similis* (Cobb) Thorne

The burrowing nematode is a serious pest of ornamental plants under glass and has become locally estab-

lished in this environment in Europe. The pest is also of quarantine significance in Asia and the Pacific and exports of susceptible plants to Japan, for example, must be subject to inspection in the growing season or soil testing before a phytosanitary certificate can be issued.

3. NEMATODES OF QUARANTINE SIGNIFICANCE NOT LISTED IN THE ANNEXES

3.1 *Meloidogyne chitwoodi* Golden, O'Bannon, Santo & Finley

The Plant Health Service continually monitors the status of pests in the EU in order to assess whether new quarantine measures are necessary. A recent example is the Columbia root-knot nematode, a serious pest of potato in the north-western states of the USA,⁶ with a very wide host range.⁷ In 1988, this species was found to be widespread on several crops in the Netherlands,⁸ and has since been recorded in Belgium, France and Germany, but not in the UK. A Pest Risk Analysis by Baker at CSL⁹ concluded that *M. chitwoodi* was capable of becoming established and causing damage in the UK, but further data were required to determine its likely economic impact. Meanwhile, the status of this pest is under review, and a survey will be carried out to ascertain whether it is present in the UK (perhaps at levels which have not yet caused economic damage).

4. NEMATODES AS INDICATORS OF PRE-EXPORT QUARANTINE FAILURES

Since the advent of the Single European Market, controls on the import of bonsai and penjing plants from outside Europe have been harmonised and, in place of the UK practice of post-entry quarantine, the country of origin has been required to implement a range of strict pre-export measures. The plants should be (a) grown in registered nurseries, (b) grown in artificial or sterilised medium, (c) grown in pots 50 cm above the ground, (d) shaken free from the medium within two weeks prior to dispatch, leaving only the minimum amounts necessary to sustain vitality during transport.

There has been a substantial increase in imports of cheap bonsai plants over the last two years, many of which are imported into the Netherlands for onward distribution throughout Europe. As well as alien insects and mites seen during inspections of these imported plants, alien species of *Helicotylenchus*, *Hirschmanniella*, *Meloidogyne*, *Tylenchorhynchus* and *Xiphinema* have been found by laboratory examination of soil samples, indicating that important requirements have not been met. Pending agreement on a united response within the

EU, the UK is considering what action it can take to safeguard the Community against the risk posed by soil pests on such imports.

5. NEMATODES AND CERTIFICATION SCHEMES

5.1 Precautions against the potato cyst nematode in the seed potato certification scheme

In the seed potato classification scheme, seed potatoes may be grown only on land tested and found free from PCN within the previous four years. Soil sampling for PCN is based on a 500-g sample made up of up to 100 cores taken from area units ≤ 4 ha, based on the method recommended by EPPO.¹⁰ Statutory sampling by PHSI is done in fields in which seed potatoes are to be grown and where plants and potatoes are to be grown for export to countries which include freedom from PCN in their import requirements. For example, there is a substantial trade in ware potatoes from Essex and Hertfordshire to the Canary Islands. Soil sampling is supported by a minimum (usually 1%) tolerance of extraneous matter (mostly soil) to further minimise the risk of spreading PCN with tubers.¹¹

5.2 Precautions against virus vector nematodes in fruit plant and bulb certification

To reduce the risk of virus transmission, soil samples are taken prior to planting certain fruit plants being grown for high grade stock as part of the MAFF certification scheme. If any virus vector nematodes (*Longidorus*, *Trichodorus* or *Xiphinema* spp.) are found, stocks for certification may not be planted in the infested land.

5.3 Nematodes in the EU Marketing Schemes for young plants

The EU Marketing Schemes for fruit plants, young vegetable plants and ornamental plants require that growers of these plants be officially accredited, and that they should ensure by means of visual inspection that the plants which they are marketing are free from pests and diseases affecting quality. Annexes to the three

Directives for these schemes list the main pests and diseases against the relevant hosts, and a number of nematodes are listed, including *Aphelenchoides*, *Ditylenchus*, *Meloidogyne*, *Pratylenchus*, *Rotylenchus* and *Tylenchulus* spp.

ACKNOWLEDGEMENTS

The authors wish to thank the numerous colleagues in the Plant Health Service in the UK who have contributed to the data in this article, and to Dr David Ebbels and Dr S. Hill (CSL) who have commented on the script.

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